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Drag Reduction Efficacy of CTABr and Nanosilica Particles Using Rotating Disk Apparatus (RDA)

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ABSTRACT

Over the years, it has been proven an energy consuming and cost effective to transport fluid in pipe, efforts that have been made to investigate this have not yielded a consensus on the mechanism and principles behind such, polymers that have been used degrade and less effective over time, surfactant which are self repair are not as effective as the polymer, recent studies on this concept with other solid particles have majorly been concentrated in pipe, this work investigated the drag reduction efficacy of silica nanoparticle with cationic surfactant, CTABr in a rotating disk apparatus, it was observed that, these material can reduce drag by 50% and are mechanically stable after degradation. Before drag could be reduced with these materials, proper proportions on the materials should be selected.

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INTRODUCTION

The concept of drag reduction is not a new one as far back as the days of Toms (1948). Nevertheless, it is almost exhaustible due to many works that have been carried out on it, many attempts have been made to postulate theories on why drag reduction takes place, and others, on the potential applications, see Manfield *et al* (1999). Reports have shown that polymer could be used to reduce drag even at the smallest quantity usually in ppms, Kulicke *et al* (1989), Virk (1970), Rose and Foster (1989) and Berman (1978). On this note, many efforts have been made to study the working principle of these materials Lumley (1969, 1973, 1997), Virk (1975) and Hlavacek *et al* (1976).

Despite these theories and postulations, yet, there is yet to be any reasonable conclusions on the main reasons while these materials reduce drag, another important point to note here is that, these polymers break down after a period of time, referred to as mechanical or thermal degradation, which occur as a result of the high shear systems associated with turbulence at which they are exposed, Pereira *et al* (2013). When this takes place, the working efficiency of these materials are reduce, Vanapalli (2005)

In like manner, another group of materials which have the ability to reduce drag and have as well been widely investigated are the surfactants, which have advantage over the polymers, which could withstand such degradation, some of the review papers on surfactants as DRAs have been published, Shenoy (1984), Gyr and Bewersdorff (1995), Zakin *et al.* (1998).

These materials are able to realign or reassemble and self repair after mechanical degradation through the formation of micelles, this has been well reported by the review papers of White and Mungal (2008), Graham (2004), Hellsten (2002) and Zakin and Ge (2010).

As a result of this attributes, they have been individually studied Ohlendorf *et al* (1986), Lu *et al* (1998), Myska and Stern (1998), Gasljevic *et al* (2007) and Qi *et al* (2011) and in combined form with polymers, referred to as complexes, Suksamranchit *et al* (2006), Anthony and Zana (1994), Mya *et al* (2000, 2001, 2003). When in complex mixtures with polymers, they could modify the properties of these polymer after mechanical degradation. Other DRAs that have been studied are solid particles, such as wood pulp fibers, Lee and

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